CONTRIBUTIONS TO THE LIFE-HISTORIES OF PLANTS, No. X.

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THE ORIGIN OF CORELESS APPLES.

There are apple trees which have occasionally apetalous flowers and bear fruit which is, as popularly stated, coreless. The precise morphology of this condition has never been explained. Recently some specimens were presented to the Academy by Mr. Anchutz of Arch Street, Philadelphia, from a tree growing on the grounds of Captain F. J. Williams, in Pleasants Co., West Virginia. Though bearing fruit abundantly every year it never had been known to have a "blossom," that is to say, petals. The corrugated appearance of the apex of the apple suggested the course of growth which results in the "navel" varieties of orange, explained in Proceedings of the Academy, July 25, 1893, p. 292, and an examination showed that a similar explanation applies to the apple as well as the orange. The ordinary apple is simply an arrested branch in which the leaves, with the axis, have been transformed into the succulent or carpellary structures

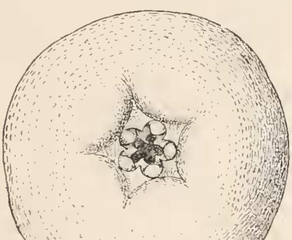

Fig. 1.

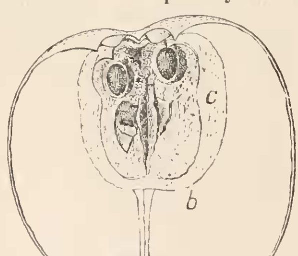

Fig 2.

which go to make up the fruit. But in these coreless apples, the growth-wave resulting in the production of fruit did not become so fully arrested, but made a renewed though weaker rhythm. This was sufficient to draw nutrition from the original fruiting wave, and perhaps interfere with its proper pollination, thus permitting the formation of an upper carpellary system,—weak, certainly, but sufficiently well situated to secure pollen and produce a few very small seeds in the upper section. The illustrations explain the process by which this coreless condition is brought about. Fig. 1 gives an external view of the apex of the apple. In the ordinary apple we havs the dry remains of five small sepals; in this we have three series of five, alternating with each other in a perfectly normal manner. The interior series of five are quite fleshy and, as they are evidently the apical portions of the five sectional protuberances in the apple, we may safely conclude that it is this series which has chiefly aided in the development of the fleshy portion of the fruit. It should have been the matrix of the petals in the normal apple, and we may infer that in this fruit, as we generally have it, with the calycine and petaliferous verticils combined, it is the inner or petal bearing series that gives the apple its chief succulency. In the normal apple, the carpellary structure commences at *a*, Fig. 2, but in this case, by the imperfectly arrested growth of the axis, it has been carried up to *b*,—and even then not wholly brought to rest, as it has made another step, *c* resulting finally in a small system capable at least of seed-bearing, though having lost most of its power to give succulence to its calycine series. We may say that a coreless apple is, morphologically speaking, but a restless attempt on the part of the tree, to develop several carpellary systems, instead of confining itself to the perfection of one, as in ordinary cases.

This phenomen is not unusual in plants. The rose, a near relative of the apple, is not infrequently seen with another small rose growing from its centre, the explanation being of the same character as here given for the apple.

It may be tersely stated that navel oranges and coreless apples are feeble attempts at proliferation.

The Relations Between Insects and the Flowers of Impatiens fulva.

Along a small stream on my grounds, masses of *Impatiens fulva* abound, growing in great luxuriance. The humming bird visits the flowers as freely as various insects. I frequently amuse myself by standing perfectly still in the midst of a mass of flowers, and have these little creatures rest on my shoulder or even on my hand when I kept it still above the flowers. While thus enjoying myself, I have been led to note many items of interest worth recording.

Variations in species are often referred to the visits of insects.

They bring pollen from other flowers, and intermediate forms necessarily result. Quite early in the modern discussions of this subject[1] I showed that variation must first occur, and that the insect visitor was rather a conservative agent than a factor in variation,—bringing back towards the original that which had departed. I have published many papers showing that variation is at least as great in monotypic species as where there are numerous closely related species or varieties to cross with. *Impatiens fulva* is another illustration. It is not necessary to recount the character of the variations. One may fairly say that no one character can be named that does not show variation in some individuals. Even the glaucous leaves are sometimes bright green, at others almost silvery. The flowers not only vary in color and markings, but the several parts of the flowers are changeable. The spur particularly is sometimes of remarkable length, at others well warranting the remark of Dr. Gray "spur rarely wanting." Aside from the fact that there is no other species near to get any aid to variation in that way, many of the colonies on my grounds are from last years' seeds. The observations on this plant confirm records I have made during the past quarter of a century that there is an innate power to vary co-existant with the species itself, independent of any conditions of environment. This may be granted without prejudice to the proposition that changes can and do occur at times by the influenee of environment, for which there is abundant evidence. It seems proper to present the strong facts on the former side, because of the modern tendency to exalt the latter as the prime motor in evolution.

The amount of nectar secreted at the base of the spur is considerable. By cutting off the apex and stripping down the tube as in milking, a globule as large as a pin's head will form at the cut. A large proportion of flowers, especially in the latter part of the season, are cleistogene. But even in these cleistogamous flowers spurs are formed. An interesting fact was that the nectar formed as freely in the spurs of the cleistogene flowers as in those which we should call normal and fully "adapted" to insect visitors!

Is there any necessary relation between the nectariferous structures of flowers and the visits of insects? The cases in which the relationship appears elose are numerous, but equally numerous

[1] On the Agency of Insects in Obstructing Evolution. Proc. Ac. Nat. Sciences, 1872, pp. 235-237.

are the cases on the other side, and this cleistogamous case is one. But in the normal flowers only a few insects could work to advantage. The spur of the nectary is incurved, and only creatures with a long and flexible tongue could reach the sweet deposits stored, mostly, at the base of the tube. In my "Flowers and Ferns of the United States" (Series II, p. 44, 1880) Prof. W. W. Bailey is quoted on the authority of a friend of his that "the sacs were all perforated by bumble bees." Numerous species have their sacs perforated in this way, and all have been charged, even by myself, to bumble bees. Dr. J. H. Schneck of Mount Carmel, Illinois, suggested to me that this is probably a mistake, and that species of *Xylocopa* (carpenter-bees) and not *Bombus*, are responsible for this act. Watching these flowers I found the slits were made by a wasp, *Vespa maculata*, that some species of *Xylocopa*, and also the honey bee, took advantage of the work of the wasp; but the only species of bumble bee I noticed working on the flowers, *Bombus Pennsylvanicus*, entered the flower every time by the flower's mouth, and got the nectar from the curved spurs as best it could. Properly speaking, the openings made by the hornet are not slits, but rough openings, chewed out. The slits proper appeared to have been made by the small carpenter bees. It is evident that in view of the many insects these flowers support, no advantage is received by the flowers in return.

The relation of *Bombus* to fertilization was next examined. The longitudinal streak of white pollen on the back of the visiting bee gave it a picturesque appearance. That he could carry pollen from one flower to the other was very apparent. It seems impossible for the visiting bee to reach the stigma, as these are protected by connivent scales under the anthers, which form a close cap covering the stigma. Usually the earlier petaliferous flowers are infertile. In these plants, early in August, numerous flowers had perfected fruit, though the great majority were infertile. In what manner did the bee or the humming bird aid in the pollination? Examining a number of flowers after these creatures had retired I was satisfied that they did not aid in any way. I have had evidence in other cases that where sufficient moisture exists, pollen tubes can reach the stigma without actual contact with it. There is abundant moisture around the stigma, and it is not improbable that the pollen tubes, by the aid of this moisture, pass over the membranous border, in many cases, to reach the stigma and effect fertilization. The positive fact gained by these observations is that neither humming birds nor bumble bees in any way aid in pollenizing the petal-bearing flowers. They are as absolutely self-fertile as the apetalous cleistogene ones.

An especially interesting observation was the existence of many plants bearing wholly cleistogene flowers among the normal petal-bearing ones. These plants were not as tall or vigorous as the petal-bearers, and could be readily distinguished from a distance by a yellowish-green tint, indicative of imperfect nutrition. It had been before suggested to me by an incidental remark of Mr. Willis in the Proceedings of the Cambridge (England) Philosophical Society, that in some unexplained way there is a relation between imperfect nutrition and cleistogamy,—a point which this observation confirms.

The sum of these observations is, that in *Impatiens fulva* variation is innate and not dependent on environment; that bright color and sweet secretions have no relation to the visits of insects; that the petal-bearing flowers are self-fertile, and that cleistogamy is the result of impaired nutrition rather than of any mere labor-saving influence.

Apetalism and seed Propulsion in Lamium purpureum.

Lamium purpureum, a well-known European species, is somewhat common as a weed on my grounds at Germantown, near Philadelphia. It exists in two forms: one with small pale lilac flowers, the other with flowers more rosy and larger. While examining the flowers with a lens to trace any difference that might exist, I was surprised to have my face peppered by the seeds which had been expelled from the calyx with considerable force. Examining plants with an abundance of seed vessels, it was seen that most of the calices were empty though still comparatively erect. The seeds, or properly nutlets, could not easily have fallen out, and doubtless propulsion is the usual method by which they are distributed.

Examining plants in the early part of July I found large numbers of the upper flowers apetalous. The calyx was perfect, the stamens were of the usual length, and the anthers profusely laden with pollen ; the pistil seemed in every respect perfect, but not the slightest trace of corolla existed. The stamens, normally borne on the corolla, were now wholly independent of each other, and hypogynous. This is probably the first case of apetalism recorded in Labiatæ.

Fruiting of Robinia hispida.

In descriptions of *Robinia hispida*, no reference is made to the legumes. In cultivation they are not known ever to be formed. The writer has searched for them in his botanical collectings in Tennessee without finding any, and it is a general belief that they are rarely produced when the plant is growing either in a wild or cultivated state. Mr. David F. Day of Buffalo, New York, notices[2] that the anthers are destitute of pollen in the flowers he examined from cultivated plants in that region, a condition often found, in most plants of *Lathyrus grandiflorus* and some other Leguminose plants. In an excursion around Linville, North Carolina, in July 1893, Mr. C. F. Saunders of Philadelphia found a number fruiting, some specimens of which have been deposited in the Herbarium of the Academy, and in the Royal Herbarium at Kew.

The Vitality of Seeds.

Antirrhinum glandulosum. Exact facts in regard to the power of seeds short-lived under ordinary circumstances to retain vitality when deeply imbedded in the earth, or under some other specific conditions, are not numerous. Hence many controversies occur between the "practical man" who *knows* they will live an indefinite time, and the man of "science," who as firmly believes they will not. The writer of this has frequently been among the doubting ones, simply because the facts adduced for long vital power, could bear other interpretations. Ten years ago his friend, the late Dr. C. C. Parry, gave him some California seeds. *Antirrhinum glandulosum* was raised from them. The following year the plot was required for buildings and covered with earth from the cellar several feet deep. No plant of it has, to a certainty, been there since until this season, when, the earth in one spot being turned up a few feet in depth, one plant came up and flowered.

Dimorphic Flowers in Labiatæ.

Dracocephalum nutans.—I have shown in various papers that a tendency to dioecism is not uncommon in *Labiatæ*. Another addition

[2]Meehan's Monthly, III, p. 118.

to the list is *Dracocephalum nutans*, a European plant which has many individuals with all the anthers sterile. The plants which bear the highly polliniferous anthers are much larger and more showy that what may be called the female flowering plants, a fact I have noted in other dimorphic species.

Some European works have noted a mixture of species, or marked varieties, of this plant in a wild state. The dimorphic character is the probable explanation.

Apetalism in Sisymbrium Thaliana.

Apetalism is not common in *Cruciferæ*. I have noted tendency in this direction in *Cakile* and in *Raphanus*. Early in the present season 1893 the plant being a common weed in my garden, I found apetalous flowers very common. Numerous instances of flowers with only one, two or three petals, were also observed. Later in the season there was seldom found any variation from the normal condition. No difference in strength, position, or any other condition could be observed that would satisfactorily account for the abortion.